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Lockheed Martin Corporation

Work Plan – Sampling and Analysis Plan for Air Monitoring

Lockheed Martin Site
The Dalles, Oregon

05 September 2012

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Lynden J. Peters
Project Manager

Chris Lutes
Principal Environmental Chemist

Kim Engler
Project Scientist

Connie Cole
Senior Scientist

Prepared for:
Lockheed Martin Corporation

Prepared by:
ARCADIS U.S., Inc.
Rosehill Office Park 1
8725 Rosehill
Suite 350
Lenexa
Kansas 66215
Tel 913 492 0900
Fax 913 492 0902

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Tables

Figures

Appendices

1. Background

ARCADIS U.S., Inc. (ARCADIS) proposes to conduct a comprehensive air monitoring event at the Resource, Conservation and Recovery Act (RCRA) and Comprehensive Environmental Response, Compensation and Recovery Act (CERCLA) landfills located on the Lockheed Martin Corporation (LMC) site in The Dalles, Oregon. ARCADIS conducts on-going Operation and Maintenance (O&M) activities at the site on behalf of LMC pursuant to Post Closure Permit No. ORD 052 221 025 issued by the Oregon Department of Environmental Quality (ODEQ). This document serves as a work plan and a Sampling and Analysis Plan (SAP), including quality assurance/quality control (QA/QC) information for this sampling event. A laboratory Quality Assurance Manual is included as Appendix A. This sampling event is being performed at the request of the United States Environmental Protection Agency (EPA) and this revised work plan/SAP has been guided by comments received from EPA reviewers. A Health and Safety Plan (HASP) addendum is included in Appendix C. A summary of the site treatment timeline is being provided under a separate cover in response to a CERCLA Request for Information (RFI) letter. An acceptance form from ODEQ is provided in Appendix D.

1.1 Sampling and Monitoring Objectives

The purpose of the sampling and monitoring event is to assess the following;

- The potential for exposure of site workers, offsite industrial workers, or residents to toxic and/or asphyxiating gases;
- The potential for auto-ignition and/or fire from explosive gases, and;
- The chemistry of various in situ treatment methods that have been employed at the RCRA and CERCLA landfills and leachate systems.

The monitoring event must also be performed in a manner that protects the safety and health of the monitoring team. A Health and Safety Plan Addendum that addresses this monitoring event is presented herein as Appendix C. Action levels specific to the health and safety program are specified in the Appendix C Health and Safety Plan.

1.2 Sampling and Monitoring Approach

The first objective listed in Section 1.1 will be met by sampling and analyzing toxic gases at potential exposure points, including the fence line and locations within the landfills. Evaluation criteria for these sample results are specified in Section 5.1 and Table 1.

The second objective will be met by sampling and analyzing explosive gases at various points around the landfills and within source areas (sumps and landfill vents). Emergency response/notification procedures are specified in Section 5.1 and the Contingency Plan, submitted under separate cover.

The third objective listed in Section 1.1 will be addressed by measuring the concentrations and flow rate of gases, including hydrogen cyanide (HCN), from the landfills. These data and measurements will also allow a determination of potential gas emissions from the landfills under defined meteorological conditions.

Monitoring locations are specified in Section 2. These include gas vents on the RCRA landfill, sumps and utility buildings associated with both landfills, the surface of the landfills, and the fence line surrounding the landfills.

1.3 Data Quality Objectives

The data quality objective (DQO) process is a series of seven planning steps based on the scientific method, designed to specify the type, quantity, and quality of environmental data needed to support defensible decisions based on current conditions and proposed activities at an environmental site (EPA 2006). The EPA seven-step DQO process was used as general guidance during the development of this study's DQOs.

DQOs are qualitative and quantitative statements derived from the outputs of each step of the DQO process that:

- Clarify study objectives;
- Define data needs (type, quality, etc.); and
- Specify acceptable levels of decision errors that will be used as the basis for establishing the quantity and quality of data needed to support the decision.

The derived statements are then used to develop scientific, resource-effective, and defensible sampling designs. A description of the DQO process is provided in the following table.

Table 4. Data Quality Objectives [1]

PROCESS	RESPONSE
Step 1 State the Problem	A RCRA landfill containing K088 waste, with a liner and leachate collection system and a multilayer cap has 3 passive vents to release landfill gas to the atmosphere. Past actions at the RCRA landfill have included injection of CO2 gas for a 10 month period in 2004 and 2005, and periodic operation of a 35 cubic feet per minute (cfm) vacuum blower on one of the vents during the dry season of the year between 2005 and 2010. Past field instrument monitoring has shown the presence of landfill gas inside the vents, including methane, hydrogen sulfide, hydrogen cyanide and depleted oxygen. There is a potential for release of landfill gas to the atmosphere from the vents, from the leachate collection sump or from the perimeter of the landfill cap. The CERCLA landfill contains K088 waste, along with other plant wastes including construction debris, off specification cryolite, anode waste, waste metal and scrubber sludge material. The CERCLA landfill is capped with a multi-layer cap with no gas vents. There is no liner, however, landfill leachate is collected in a perimeter trench and treated using biological processes. Actions that have been taken in the past have included addition of a carbon source (molasses and methanol) to the toe of the landfill where it infiltrates to the leachate collection system. Currently, the molasses and methanol is fed into the primary leachate lift system and periodically added to intermediate manholes that connect to the leachate collection system. Areas with potential to release contaminants to the environment include the manholes in the leachate collection system or from the perimeter of the landfill cap.

[1] USEPA. 2006. *Guidance for the Data Quality Objectives Process*, EPA QA/G-4. Final. EPA/600/R-96/-55. August.

PROCESS	RESPONSE
STEP 2 Identify the Goal of the Study	The specific goal of this air monitoring, and air sampling and analysis, is threefold: • To assess the potential for exposure to toxic gases and asphyxiating gases for on-site workers and off-site commercial and industrial workers • To assess the potential for auto-ignition and/or fire from explosive gases • Collect data to be used as a diagnostic tool to assess the chemistry of various treatment methods employed at the site.
STEP 3 Identify Information Inputs	• Ambient air monitoring data for acetylene, ammonia, carbon dioxide, hydrogen fluoride, hydrogen, hydrogen cyanide, hydrogen sulfide, methane, nitrogen, oxygen, phosphine, using hand held field monitoring instruments. These measurements will be conducted during the perimeter survey around each landfill, during landfill surface and building surveys, and sampling and monitoring of landfill manholes, vents, sumps and lift stations • Wind direction, speed will be monitored using a wind sock and hand held instruments during all surveys • Barometric pressure and trends will be monitored on-site using a logging barometer • RCRA landfill vent flow rates and direction will be monitored using a laminar flow element and micromanometer. • Ambient air samples collected for definitive analyses for acetylene, ammonia, carbon dioxide, hydrogen fluoride, hydrogen, hydrogen cyanide, hydrogen sulfide, methane, oxygen and phosphine. These data will be collected during the perimeter sampling around each landfill, during landfill surface and building sampling, and sampling of landfill vents, sumps and pump stations • Air samples collected from the site locations and analyzed by definitive methods using appropriate USEPA, OSHA, ASTM and NIOSH analytical methods with detection limits that are appropriate for the intended use • Field/trip blanks will be collected/prepared to assess the presence of the chemicals from sources other than ambient air. Field duplicate samples will be collected to assess the precision of the field sampling methods

PROCESS	RESPONSE
STEP 3 (cont.)	• Laboratory and glassware blanks will be analyzed to assess intra-laboratory sources
STEP 4 Define the Boundaries of the Study	The areal boundary of the study is the LMC owned properties in The Dalles, Oregon, within and adjacent to security fences for the RCRA and CERCLA landfills. The vertical boundary is ground surface to 5 feet above ground surface for all samples except for the RCRA landfill vents and CERCLA landfill vents, which may extend up to 5 feet below land surface within the vent system.
STEP 5 Develop the Analytic Approach	Ambient air will be analyzed by appropriate USEPA, OSHA, ASTM and NIOSH analytical methods. Real-time monitoring results will be used for health and safety monitoring and to assist in selection of locations for definitive analysis and to supplement the definitive data collected. Measurements will be made using real time monitoring for ammonia, carbon dioxide, hydrogen fluoride, hydrogen, hydrogen cyanide, hydrogen sulfide, methane, oxygen, phosphine, and wind direction speed, vent flow and barometric pressure and trend. Air samples for offsite analysis will be collected for the analysis of acetylene, ammonia, carbon dioxide, hydrogen fluoride, hydrogen, hydrogen cyanide, hydrogen sulfide, methane, oxygen and phosphine. The target practical quantitation limits (PQLs) for all parameters are shown in Table 3. Results will be compared with screening levels shown in Table 1. Results in excess of the screening levels will indicate a potential for exposure that will require further evaluation.

PROCESS	RESPONSE
STEP 6 Specify Performance or Acceptance Criteria	Analytical data reported by the laboratory will be reviewed by the ARCADIS quality assurance officer after validation by an independent organization. The selection of an independent third party reviewed is in process. An independent third party firm will be selected and submitted for EPA and ODEQ approval. Data validation will be performed using Level IV protocols (full raw data review) of the detailed data packages from the analytical laboratory. Reviewed data will be assessed for usability as described in Table 3 to ensure that the PARCCS data quality indicators are met. Data review will determine if collected data may be used for comparison. In general, it will ensure that: • Appropriate field QC sample procedures were followed; • Deviations were documented and assessed; • Data met applicable criteria; and • Data are usable for the stated project needs All samples submitted to the analytical laboratory will be analyzed by the USEPA, OSHA, ASTM and NIOSH analytical methods identified in Table 1. Laboratory achievable PQLs for analytical methods are listed in Table 3.
STEP 7 Develop the Plan for Obtaining Data	• Table 2 provides a summary of the number and types of samples for definitive analyses, including QA samples

2. Field Sampling and Monitoring Activities

The structure and layout of the RCRA and CERCLA landfills in relation to the site as a whole and to the City of The Dalles is shown on Figure 1. As shown on Figure 1, the landfills are located adjacent to the area formerly occupied by the Northwest Aluminum Company (NAC) facility. The area surrounding the former NAC plant consists of industrial property on all sides.

As these are closed landfills, there are no full time staff onsite within the fenced perimeter. However, there are authorized workers who enter the site periodically. These include the following:

- ARCADIS employs a technician to operate the CERCLA leachate treatment system. This staff member works approximately 15 hours a week. He periodically adds nutrients to the CERCLA leachate collection system (LCS) via enclosed tubing at Manhole 4 and by manually pouring in measured amounts to Manholes 2 and 3. No worker access to the LCS is required. The treated leachate collects at lift stations; where it is pumped to the 300,000 gallon CERCLA tank. When tank volumes approach approximately 150,000 gallons, a leachate sample is collected from a port on the tank for analysis. Leachate that meets the Outfall C limit for WAD cyanide (0.1 mg/L) is pumped from the CERCLA tank through a pipeline to National Pollution Discharge Elimination System (NPDES) discharge Outfall 001. Worker tasks include starting and stopping the discharge pump and monitoring the effluent meter. Typically, four to six discharges occur during the year.

- On-site duties also include quarterly and annual inspections of the CERCLA LCS and the landfill cover. The annual inspection monitors the condition of the cover, the storm water drainage system and areas around the landfill for erosion and settling, and the condition of fences and gates. The quarterly leachate collection system inspection includes checking all pumps, alarm systems, the piping system and a visual inspection of the tank.

- The ARCADIS technician is also responsible for similar inspection compliance on the RCRA landfill; quarterly inspections of the LCS and annual inspections of the landfill cover. Inspections cover similar monitor points as for the CERCLA landfill with the addition of checking the lightning rods on the RCRA landfill. Leachate from the RCRA sump is transferred on an as-needed basis to the CERCLA tank for treatment prior to discharge through the NPDES discharge outfall.

- The ARCADIS technician also conducts an annual inspection of the Scrubber Sludge Ponds to monitor the integrity of the soil cap on the ponds and the condition of the fence.

- Power line workers also have site access with prior notification and coordination with ARCADIS staff. A transmission line transects the area fenced for the CERCLA landfill and is adjacent to and outside the RCRA landfill fenced area.

- ARCADIS staff also are onsite to collect groundwater data from compliance wells adjacent to the landfills once or twice a year. Air monitoring activities as discussed in this work plan/SAP also require site access.

- Representatives of the site owner or regulatory agencies may periodically visit the site.

Section 2.2 (Landfill perimeter monitoring), Section 2.3 (Landfill surfaces and utility buildings), and Section 2.4 (vents, sumps, and pump stations) specify the details of the field sampling program. These efforts are intended to address the three study objectives as follows:

<u>RCRA and CERCLA Landfill Perimeters</u> – The primary concern associated with the RCRA and CERCLA landfill perimeters is considered to be potential exposure to industrial workers on adjacent properties or trespassers at the perimeter of the landfill fences, which addresses objective 1. This exposure assessment monitoring will be initiated at the access gates of each landfill, and will include a monitoring point at the most likely downwind location. Explosive gases will also be measured at the landfill perimeter, which addresses objective 2.

<u>RCRA and CERCLA Landfill Surfaces and Buildings</u> – The concerns associated with the landfill surfaces and utility buildings are considered to be intermittent site worker exposure (objective 1) and potential for auto-ignition of gases associated with the wastes entrained in the landfills (objective 2). Therefore, gases at these locations will be tested for explosive, asphyxiating, and toxicity characteristics to define appropriate health and safety management practices.

<u>RCRA Landfill Vent Caps and CERCLA Landfill Sumps</u> – Concentration measurements for compounds of concern from within the vents, manholes, lift stations and landfill sumps will be obtained along with gas flow measurements to characterize the sources. These measurements will be used to address all three study objectives.

In accordance with EPA direction provided by Region 10 staff in the June 18, 2012 e-mail, the gases to be monitored at the landfills are:

- Methane (CH_4)
- Oxygen
- Hydrogen Sulfide (H_2S)
- Carbon Dioxide (CO_2)
- Hydrogen Cyanide (HCN)
- Hydrogen
- Nitrogen
- Hydrogen Fluoride
- Acetylene
- Phosphine
- Ammonia

Sampling and analysis methods to be used are summarized in Table 1. The test matrix is provided as Table 2. Figure 2 shows the RCRA landfill, including labels on the main sampling locations and a detail of the vent design. Figure 3 shows the CERCLA landfill, including labels on the main sampling locations. The text in this section provides descriptive information to supplement these tables and figures. Additional information is provided in Appendix B: Methods, Sampling Instruction Sheets and Standard Operating Procedures (SOPs).

The monitoring approach is described in the following four subsections as follows:

- Preliminary Screening Level Approaches are discussed in Section 2.1.
- The Perimeter. Section 2.2, RCRA Landfill Perimeter and CERCLA Landfill Perimeter, details how sampling will be conducted around each perimeter.

- Site Worker Exposure Areas. Section 2.3, RCRA Landfill Surface and CERCLA Landfill Sump Vicinity, details the sampling strategy in the areas within the fenced perimeter of each landfill where workers are most likely to be exposed. Sampling approaches for the utility buildings and sheds will also be discussed.

- Sources. Section 2.4, RCRA Landfill Vents and CERCLA Landfill Sumps, discusses the point sources at each landfill and how sampling will be conducted.

Section 2.5 discusses calibration of field monitoring instruments. Section 2.6 describes staffing of the field monitoring and sampling work, including the qualifications of the planned field team leaders. Section 3 discusses extractive sampling and laboratory analysis.

This monitoring design includes a combination of field monitoring methods and extractive sampling methods with laboratory analysis. Field instrument readings will allow for comparison to previous vapor monitoring data, support selection of sampling locations, and protect the field sampling team. OSHA recommends the use of direct-reading instruments for industrial hygiene decision making, an application that is especially appropriate in a situation like this where exposure is controlled by the concentration of the source as well as dispersion and thus weather:

> *Direct–reading instruments (sometimes termed real-time instruments) provide information at the time of sampling, thus enabling rapid decision-making. These instruments can often provide the trained and experienced user the capability to determine if site personnel are exposed to concentrations which exceed instantaneous (ceiling or peak) exposure limits for specific hazardous materials. Direct-reading monitors can be useful in identifying oxygen-deficient or oxygen-enriched atmospheres, immediately dangerous to life or health (IDLH) conditions, elevated levels of airborne contaminants, flammable atmospheres, and radioactive hazards. Periodic monitoring of airborne levels with a real-time monitor is often critical, especially before and during new work activities. Data obtained from direct-reading monitors can be used to evaluate existing health and/or safety programs and to assure proper selection of personnel protective equipment (PPE), engineering controls and work practices.*[2]

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[2] http://www.osha.gov/dts/osta/otm/otm_ii/otm_ii_3.html#direct-reading_instrumentation see also http://www.osha.gov/dts/shib/shib050404.html

The analytes requested by EPA to be monitored by field and/or extractive methods are: acetylene, ammonia, carbon dioxide, hydrogen fluoride, hydrogen, hydrogen cyanide, hydrogen sulfide, methane, nitrogen, oxygen, and phosphine, which include the gases that would contribute to potential LEL conditions. In general, the intent is to at minimum screen for all of these parameters at each location (perimeter, site worker exposure area, and sources) and then to use extractive sampling methods, where appropriate to obtain laboratory measurements of the gases. Section 2.2 describes the combination of field monitoring and extractive sampling methods to be conducted at the landfill fence lines.

Weather conditions will be noted at the time of monitoring, particularly wind direction and speed. Falling barometric pressure is widely recognized to contribute to landfill outgassing[3] and some state guidance documents call for sampling during conditions of falling or low barometric pressure.[4] Barometric pressure trends will be determined prior to sampling, and a portable barometer will be used to during all sampling activities. An effort will be made to sample from the RCRA landfill vents, the CERCLA manholes, and from the area just outside these structures during a period of falling barometric pressure. If ideal barometric conditions are not encountered, EPA may be consulted to determine sampling times. Sampling will only be conducted under falling or stable barometric conditions, as this will be the mostly likely scenario where outflow conditions would be present at the landfill vents. Following receipt of the laboratory analyses, we will incorporate those results with the field measurements in our report. We will accompany this report with a recommendation for an appropriate strategy for evaluation of temporal variability and to assess the need for long term monitoring to provide reasonable assurance that the approved remedy remains protective. This analysis will include an evaluation of operating practices, engineering controls and institutional controls to determine if any changes are warranted based on the monitoring and sampling results.

2.1 Preliminary Screening Level Monitoring Completed

Screening-level air monitoring was conducted on July 7, 2012 at the request of ODEQ (results of which were transmitted to ODEQ and EPA Region 10 under a separate cover on July 21, 2012) and using the methods discussed in the site HASP in place at that time. Barometric pressure was stable during that screening level air monitoring

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[3] http://www.atsdr.cdc.gov/hac/landfill/html/ch2a.html

[4] http://portal.ncdenr.org/c/document_library/get_file?uuid=da699f7e-8c13-4249-9012-16af8aefdc7b&groupId=38361 and http://www.dnr.mo.gov/pubs/pub2053.pdf

period, and results therefore are only representative of that barometric condition. That information has been used to optimize the air sampling design for the comprehensive monitoring design presented here. In general, the results of sampling showed:

- Landfill gases were detected in the elbows of the RCRA vent pipes; however, no landfill gasses were detected outside the vents. All of the landfill gases monitored for were detected in the vents; however, the meter did not reach the LEL in any of the vents.

- In the RCRA sump, the oxygen level was reduced from 20.9 to 20.4%. No landfill gasses were detected in the RCRA utility building and RCRA sump.

- At the CERCLA landfill lift stations and manholes gases detected were H_2S, CO_2 and HCN. No CH_4 was detected and the LEL registered zero. Outside the lift stations and manholes at 1 foot and 5 feet above ground measurement levels, no landfill related gasses were detected. Readings were taken as close as 6 inches directly above the open manholes.

Similar screening level approaches using field portable instrumentation will be performed as part of a comprehensive monitoring round described in this document.

2.2 RCRA and CERCLA Landfill Perimeters: Field Monitoring and Extractive Sampling

The perimeter monitoring round will begin with a complete perimeter survey of both landfills using portable direct reading instruments (MX6 I-Brid™ and RKI Eagle 2 monitor, or equivalent) to ensure protection of sampling personnel and to survey the landfill perimeters to assess current conditions and identify any “hot spots.”

Each perimeter will be walked with the MX6 I-Brid™/RKI Eagle 2 monitors in a survey mode with time-stamped datalogging for those gasses amenable to field instrument monitoring (all analytes except for hydrogen fluoride; hydrogen, methane and acetylene will be monitored for LEL as described below). Global Positioning System (GPS) data will also be recorded with a synchronized time stamp. If any substantial indications of landfill related gases are detected on the perimeter at any place during that walk, this information would allow that location to be mapped. These handheld monitors will be held at waist level, approximately 3 feet above the ground surface during the survey. The surveyor will begin the survey at the fence entrance location of each landfill. The surveyor will stop every 200 feet to allow the monitors to collect a stabilized reading before proceeding. Additionally, a downwind location will be monitored and recorded based on field conditions regardless of the 200 foot spacing criteria. If at any of these locations significant indications of landfill associated gasses are noted (i.e., for perimeter monitoring, any detection of HCN or hydrogen sulfide, or greater than 5% LEL), then a field screening colorimetric tube for hydrogen fluoride will also be collected at that location in addition to the field monitoring criteria described above. Note that hydrogen fluoride will also be monitored regularly on 30 minute intervals during this task in accordance with the HASP (Appendix C).

The MX6 I-Brid by Industrial Scientific will be used in lieu of the GasAlertMicro5, which was unable to accommodate all of the sensors needed to complete the target analyte list. It will be used to monitor for ammonia (ppmv), hydrogen (ppmv), hydrogen cyanide (ppmv), methane (ppmv), and phosphine (ppmv).

The RIK Eagle 2 monitor can be configured with a variety of sensors. It is anticipated that this monitor may be used to analyze the following gases in the field: oxygen (% volume), hydrogen sulfide (ppmv), ammonia (ppmv), hydrogen cyanide (ppmv), and phosphine (ppmv). By using the thermal conductivity (TC) sensors, highly combustible gases like hydrogen, methane, and acetylene will be analyzed.

The full suite of gases listed above will be tested for both LEL conditions (hand held monitor) and for toxicity characteristics. Nitrogen content will be calculated by subtracting major gas percentages from the typical concentration of nitrogen in ambient air. The primary risk for hydrogen and methane and acetylene is explosive risk. The LEL meter will be used for these compounds to help ensure worker safety. Data from these perimeter surveys will be combined with meteorological information to select four perimeter locations at each landfill to be monitored with extractive sampling. The one upwind and three downwind extractive sampling approach shown in EPA 1993,[5] will be used at each landfill, for a total of eight extractive sampling locations.

Figure 4 shows a windrose depicting approximately one year of data at the nearest weather station, which has call letters KDLS in The Dalles, Oregon, located at the Municipal airport. Wind direction is typically from the northwest. During all periods of sampling, the National Weather Service (NWS) weather observations for the Dalles Municipal Airport at http://mesowest.utah.edu/cgi-in/droman/meso_base.cgi?stn=KDLS will be frequently monitored. This weather station is approximately 2 miles from the site. In addition, winds will also be monitored onsite with a windsock and handheld wind meter such as the Kestrel 1000, Dwyer wind meter, or equivalent.

[5] Air Superfund National Technical Guidance Study Series Volume IV Guidance for Ambient Air Monitoring at Superfund Sites (Revised) EPA-451/R-93-007.

2.3 RCRA and CERCLA Landfill Surface and Buildings: Field Monitoring and Extractive Sampling

Following completion of the perimeter surveys and verification that HASP action levels are not exceeded, the ambient air quality will be assessed (with the same hand-held meters used for the perimeter measurements) at the following locations in preparation for Section 2.4 monitoring of the sources:

- Adjacent to the RCRA landfill sump, three vents, and cap drains (point sources)
- Within the RCRA utility building
- Adjacent to the CERCLA landfill's four manholes and two lift stations (point sources)
- Within the nutrient shack and CERCLA Utility Building

Monitoring in structures will be performed at any entry points to the building including cracks, seams, wall vents, utility penetrations (water lines, sewer lines, conduits, etc.), and the edge of the slab, where it meets the exterior walls. If no improved floor is present, the probe will be placed 1 foot above the soil for a minimum of 30 seconds. For the case of the RCRA utility building, probes will be attached to the monitors and extended into the structure through wall vents and under the doors. Once monitored, the building will be opened for to monitor sump gases. While personnel are in the building, doors will remain open. If at any of the breathing zone locations significant indications of landfill associated gasses are noted, then at least one field screening colorimetric tube for hydrogen fluoride will also be collected at that breathing zone location. HASP protocols will be followed.

The point source survey readings of landfill vents will be taken as the surveyor is walking in from the fence line, and until they reach a position downwind and 2 feet away from each vent. Measurements will be taken at or in the breathing zones. At a minimum, breathing zone measurements will be taken at a height of 5 feet and at the height of the vent, where a worker might bend down to pick up an object. If at any of these locations significant indications of landfill associated gasses are noted, then at least one field screening colorimetric tube for hydrogen fluoride will also be collected at that point source.

Monitoring in structures will be performed at breathing zone height near the center of the building or usual work space, if any. In addition, LEL will be monitored in potential areas where lighter than air gasses could accumulate in the following manner:

- Place the intake of the instrument probe as close to the ceiling as possible and hold the probe there for a minimum of 30 seconds to allow the air/gas to reach the instrument's sensor.

- Place the intake of the instrument probe into any confined space of substantial volume where methane could accumulate, such as wall cavities, vaults, etc. (if any are present).

In order to gather information on the pattern of dispersion in the immediate vicinity of the point sources, readings will also be taken:

- At the height of the vent or one foot above ground surface for non-vent samples and laterally one foot from the point source in all four cardinal directions[6]

- Five feet above ground surface and laterally two feet from the point source in all four cardinal directions

- Five feet above ground surface and five feet laterally from the point sources in all four cardinal directions

- A measurement of wind speed and direction will be made at this time at each point source.

Following the point source screening detailed in Section 2.4, extractive sampling for subsequent laboratory analysis will also be performed at locations determined to represent the "worst case" scenario. Selections of "worst case" will be made based on the highest survey readings taken at each location:

- RCRA landfill sump and the worst case of the three vents (two total locations) at 1 foot away from the vent at vent height

- Worst case manhole and lift station at the CERCLA landfill (two total locations)

- Worst case of the three support buildings (RCRA utility building, nutrient shack, and CERCLA utility building)

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[6] This measurement will be done with a probe or instrument extended at arm's length. We will not place an employee's head at this position for health and safety purposes as this would be expected to represent "worst case" conditions.

2.4 RCRA and CERCLA Landfill Vents, Sumps and Pump Stations: Field Monitoring and Extractive Sampling

The hand-held surveys and extractive sampling will be conducted at each source location: at the RCRA landfill sump and three vents, and at the CERCLA landfill's four manholes and two lift stations.

Figure 5 shows the planned attachment of a flow measurement and sampling manifold to the vents. This manifold has been designed to:

- Minimize exposure of the sampling team to the undiluted landfill gas
- Allow flow measurement with a laminar flow element while minimizing any backpressure on the system that could change the flow
- Provide appropriate sampling locations for withdrawal of gasses while flow is simultaneously measured

Workers will be directed to minimize the time in the immediate proximity of the vent caps to the time needed to attach an appropriate probe and then back away and conduct most of the monitoring through the probe from a distance of at least 5 feet from the point of discharge. These source monitoring procedures are further detailed in the HASP.

The perforated caps will be temporarily removed and the air flow through the vents will be measured at the laminar flow element based on a modified form of EPA method 2C or 2D.[7] Sensitive measurements of differential pressure across the laminar flow element using a micro-manometer will be used to determine average flow. If the flow is too small to measure with any available equipment suitable to the vent size, then at least an upper bound on the flow rate will be determined[8].

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[7] Method 2C—Determination of Gas Velocity and Volumetric Flow Rate in Small Stacks or Ducts(Standard Pitot Tube) http://www.epa.gov/ttn/emc/promgate/m-02c.pdf
Method 2D—Measurement of Gas Volume Flow Rates in Small Pipes and Ducts http://www.epa.gov/ttn/emc/promgate/m-02d.pdf

[8] Engineering design and part selection has not yet been completed for this system. But as an illustrative example the Meriam 50MH10 series laminar flow element for 2" vent pipe if used with a micromanometer sensitive to 1 Pa would be expected to be able to detect a flow of 0.5 liter per minute (if linear in this range) which through a 2" pipe would be a very small velocity, 25 cm/min.

An attempt will be made to obtain a sample from 5 to 10 feet within the vent pipe itself depending on field conditions and the conditions within the pipe itself. Concerns regarding worker safety and the configuration of the vent pipe will determine whether this sample is collectable or not.

RCRA landfill gas measurements will be collected at the three gas vent locations as indicated on Figure 2 and as described above. The venting system on the RCRA landfill was designed to allow gases to collect in a sand layer under the high density polyethylene (HDPE) cap and be directed to the vent pipes. The vent pipes were designed with perforated caps to allow the collected gases to vent from the landfill into ambient air.

CERCLA landfill gas measurements will be collected from the four manholes and Lift Stations 1 and 2 (Figure 3). No physical entry into the manholes or lift stations will be required to obtain the monitoring results. Data will be collected via tubing extended to approximately 10 feet below the surface elevation.

2.5 Field Monitoring Instrument Calibration Procedures

All field monitors will be calibrated per manufacturer's instructions and documented in the field notebook before the monitoring event (a zero, span gas and an additional standard to confirm linearity over the range of interest). A bump test will be performed before each day's use to confirm the monitor's ability to respond to gas by exposing the detector to a gas concentration within the calibration range. Manufacturer's instructions for calibration and purging will be followed during the real time monitoring event. The combustible sensor will be checked with a known concentration of calibration gas after any known exposure to catalyst contaminants/poisons (sulfur compounds, silicon vapors, halogenated compounds, etc.). If an alarm occurs due to high concentration of combustible gases, recalibration will be performed, or if needed, the sensor will be replaced.

Monitoring will be conducted according to the following procedure:

- The field monitors will be checked prior to each monitoring period (no less than at the start of every day) and zeroed if necessary.

- Read and record (datalogging with GPS) concentrations of the target analytes as the perimeter sampling is being conducted at both the RCRA landfill and the CERCLA landfill as described previously. Any extractive samples collected for toxicity analyses requiring laboratory analysis will be collected after hand-held gas monitoring is completed.

- As detailed in Section 2.3, read and record (datalogging with GPS) concentrations of the target analytes as each point source is approached and within each building. Gases collected from each source for toxicity analyses requiring laboratory analysis will be collected after hand-held gas monitoring is completed.

- Purging of the monitors is required until the readings stabilize at all locations other than the walking perimeter survey.

2.6 Air Sampling and Monitoring Personnel

The comprehensive air monitoring and sampling requires personnel that are highly experienced with the air sampling methods being employing. We propose one or more of the following to serve as the air sampling crew leader in the field since the exact field sampling dates are not currently known:

- Gene Stephenson, B.A., has over 30 years of experience in ambient, indoor, and source air sampling and analysis. He is highly experienced in manual and Continuous Emissions Monitor (CEM) methods for sampling and analyzing, ambient air, indoor air, stacks, and process streams. He is experienced in the maintenance and repair of a wide variety of instrumentation and equipment used in these activities. He has supervised test programs conducted on virtually every type of commercial and industrial pollution source with particular emphasis on control technology and instrumentation evaluation. He is currently Senior Test Engineer at the Research Triangle Park Office of ARCADIS and is working on a EPA project to determine the emissions from prescribed burning of forest and agricultural lands and forest under-burden and agricultural materials in a controlled (burn hut) setting. He has led field teams for projects for EPA’s Office of Research and Development (including landfills), for the National Cooperative Research Program Transportation Research Board and numerous commercial clients.

- Chris Winterrowd, B.S., has 18 years’ experience in the air-emissions monitoring industry. He serves as a Staff Research Engineer in the Environmental Monitoring and Engineering Business Unit at the Research Triangle Park, North Carolina office. His responsibilities include responding to requests for test plans and budget estimates from government and corporate clients, developing testing scopes using promulgated and proposed methods as well as methods still under development, and project management and technical direction of projects for industry and government. He is knowledgeable in most EPA standard manual and continuous emissions methods and equipment and is experienced in their use for research and facility compliance purposes. Most recently, Mr. Winterrowd has worked extensively with speciating mercury continuous emission monitoring systems in bench-scale, pilot-scale, and full-scale studies.

- Brian Kaufman, B.A., has more than 22 years of experience with our in-house source testing group. His duties focus on managing the staff and finances of the group, writing cost proposals, and establishing technical protocols for stack testing programs. He also handles the scheduling of personnel and equipment for the groups' fieldwork, as well as personally conducting some stack tests and CEM certifications in the field. Other responsibilities include managing and assisting others with stack test projects, mediating between regulatory agencies and clients to achieve acceptable terms for these programs, interpreting and calculating data, and assisting with final reports. His experience includes several test programs at landfill flares in at least four states.

- John Kirby, B.S., has over 26 years of experience in environmental testing and laboratory analytical procedures. His responsibilities include technical and administrative oversight of various air emission testing projects for compliance with state and federal regulatory requirements. Primarily, Mr. Kirby is involved with instrumental analysis of smokestack emissions, and often performs various wet chemical stack test procedures. Mr. Kirby routinely develops spreadsheets for mass emission calculations and emission flow rates.
  Mr. Kirby moved to the stack sampling group of ARCADIS in 1999. He has been involved in testing more than 200 air emission sources including landfill flare. Prior to that, his work focused on industrial process and non-process water monitoring projects for compliance with discharge permits and other regulatory requirements.

3. Extractive Sampling Methodology and Methods

Specific sampling methodologies are established in Table 1 – Air Monitoring Methods. This table is divided into two categories:

1. Extractive Analyses

2. Field Monitoring

The table specifies how each analyte will be sampled and measured. Information on method detection limits and screening levels utilized for assessment purposes is included in the table. The Test Matrix is shown in Table 2, and indicates the initial breakdown of field screening (hand-held monitors) and extractive methodologies that will be employed at each location. Flow rate out of the vents will be monitored during sampling to ensure that the sampling flow rate does not exceed the natural vent flow rate. If the flow rate out of the vent is less than this, the plan will be adjusted in the field by lowering the flow rate and/or extending the sampling time to achieve the best possible dataset.

All extractive sample analyses will be performed by ALS Environmental (formerly Columbia Analytical Services) in Simi Valley, California, with the exception of HCN, hydrogen fluoride, and phosphine which will be performed by their Salt Lake City, Utah laboratory. The Simi Valley laboratory is American Industrial Hygiene Association (AIHA) and National Environmental Laboratory Program (NELAP) certified, and the Salt Lake City laboratory is AIHA certified.

Table 1 (Air Sampling and Monitoring Methods) details the sampling procedures required for each of the extractive methods. Acetylene, carbon dioxide, hydrogen, methane, nitrogen, and oxygen are collected by Tedlar bag or canister. Hydrogen sulfide is collected by Tedlar bag and sorbent tube. Ammonia is collected with a treated anasorb tube. Hydrogen fluoride, hydrogen cyanide, and phosphine are collected with SKC samplers. It is anticipated that all of these samples will be time integrated.

The detection limits/practical quantitation limits (DL/PQL) listed in Table 1 for sorbent tubes are dependent on the volume collected (in liters [L]) on the sorbent tube. For example, if the method reporting limit (MRL) is 0.21 microgram (µg)/sample and a 100 L volume is used for sample collection, the calculation for DL/PQL would be:

(0.21µg/sample/100L)(1000) = 2.1 micrograms per cubic meter (µg/m$^{3)}$

The ALS Environmental laboratories will provide the Tedlar bags, canisters, and any tubes used in sampling. Method blanks are included with all analyses as quality control samples. This lab routinely receives ASTM-D-5504 (gas chromatograph with Chemiluminescense detector) Tedlar bags which will be shipped overnight to the laboratory for analysis within the 24-hour holding time. All efforts will be made for the air samples collected in Tedlar bags will be analyzed within 24 hours of sample collection for all parameters. When possible, a laboratory spiked blank (LCS) will be made and stored and analyzed with the samples to monitor possible losses while in transport/storage. If it is not possible to include an LCS with these samples, every effort will be made to overnight deliver these samples to the laboratory and request that they be analyzed immediately.

Laboratory QC samples will be for the extractive analyses only and will follow the guidelines specified in each method. The Field Monitoring Instrument Calibration Procedures are detailed in Section 2.5

A number of research studies have shown that some loss of hydrogen sulfide inevitably occurs in Tedlar Bags after even a short 24-hour holding time[9]. That fact should be taken into account in data interpretation. For this project, results of sorbent tubes (for hydrogen sulfide) and direct reading field instruments will be compared to the Tedlar bag laboratory analytical results. If the field results are 30-50% higher, then losses in storage should be suspected. The fence line projected detection limit (5.6 $\mu g/m^3$) is 35% below the screening level (8.8 $\mu g/m^3$). Since screening levels normally contain large safety factors, it is highly unlikely that loss on storage will result in a false negative that would lead to a wrong decision. Since the fence line screening level for hydrogen sulfide is above the odor threshold, olfactory observations provide an additional safety factor to protect against false negatives due to instability of hydrogen sulfide in trace level extractive samples.

Method ASTM-D-5504 does not cover sample collection extensively, and simply says, “Samples are delivered to the laboratory in Tedlar bags with polypropylene fittings or other inert fittings at atmospheric pressure, protected from heat and light. Samples normally must be analyzed within 24 hours of sampling.”

[9] Traube, S. et al. *“Field sampling method for quantifying volatile sulfur compounds from animal feeding operations*” Atmospheric Environment 42 (2008) 3332–3341. And Hansen, M. et All “Stability of Odorants from Pig Production in Sampling Bags for Olfactometry” Journal of Environmental Quality Vol.20 #4 p 1096-11022, 2011.

Sampling pumps will be calibrated onsite prior to use for all NIOSH methods using a Buck Flow Calibrator or similar device and a dummy tube of the type to be used in sampling. NMAM 6010 and NMAM 7903 flow rates are 200 milliliters per minute (ml/min). Sampling pump flow rates will also be verified with the Buck flow calibrator at the conclusion of sampling. Power is available onsite at the CERCLA lift Stations, the CERCLA tank and the RCRA shack. An extra tube will be ordered for calibrating the pumps onsite.

NMAM 6010 will be used for the HCN analysis. The MRL is 0.21 µg/sample, or 2 parts per billion by volume (ppbv)/2.2 µg/m^3, achievable based on sampled volume and sensitivity of the underlying analytical technique. This will alleviate the concern over the higher MRLs for OTM029 (CTM-033). The presence of hydrogen sulfide at significant levels may interfere with the analytical method for hydrogen cyanide: NMAM 6010. This will be taken into consideration should any significant levels of hydrogen sulfide be detected.

4. Quality Assurance Project Plan

4.1 Field Screening Instruments

Sampling and analysis methods to be used are summarized in Table 1 which includes detection limits and screening levels. Screening levels for occupational exposures are provided in the HASP. The test matrix is provided as Table 2. Table 3 provides data quality objectives for accuracy, precision and completeness. Procedures for calibration, continuing calibration, and linearity checks, are provided in Section 2.5 and Appendix B.

4.2 Extractive Sampling and Laboratory Analysis

Sampling and analysis methods to be used are summarized in Table 1, which also includes holding times, detection limits and screening levels. Screening levels for occupational exposures are provided in the HASP. The test matrix is provided as Table 2 which includes an enumeration of the planned blanks and duplicates. Table 3 provides data quality objectives for accuracy, precision and completeness.

Procedures for sampling including verification of sampling flow rate, sample media preparation, glassware cleaning and sample recovery are provided in Section 3 and Appendix B. Laboratory Quality Assurance Project Plans (QAPPs) for the extractive samples for the two laboratory locations involved are provided as Appendix A.

4.3 Field Notes

4.3.1 Field Logbooks

Field logbooks will be used to document activities during this study. Logbooks are used to document where, when, how, and from whom any vital project information was obtained. Each activity will be documented in a logbook in such a manner that the study can be reconstructed in the future by a third party. Logbooks will have consecutively numbered pages. All entries will be legible, written in ink, and signed by the individual making the entries. An example of the type of information to be recorded is:

- Weather conditions
- Concurrent sampling activities
- Individuals present during the day

- Exact sampling locations
- Methods used to collect samples
- Field instrument calibration and quality control checks
- Sample container identification or instrument identification
- Initial and final pressure of canisters
- Date and time of sample collection
- Types of samples
- Field instrument readings
- Other field observations
- Photographs

A digital image of each sampling location and description will be acquired at the time of sampling and included with the field notes.

4.4 Sample Chain-of-Custody

All sample media prepared by the laboratories, including sampling canisters, impinge solutions and sorbent cartridges, will be submitted with certification documentation and traceable chain-of-custody (COC) forms. This documentation will be verified and receipt of sampling media will be recorded in the field logbook.

All samples will be submitted to the laboratories following COC procedures and with a COC form. The COC records will contain the following information:

- Field Sample ID
- Date and time collected (start and stop)
- Analysis Requested
- Matrix

- Sample type
- Sampler Name & Signature
- Date and Time Relinquished
- Remarks

The COC record will be signed by the sampler and relinquished to the sample custodian.

4.5 Data Review and Verification

Data will be initially reviewed by the laboratory supervisor who will prepare a case narrative noting any deviations from the method/QAPP. Similarly the field team leader will review field data from screening methods and extractive sample collection. Critical data verification will be conducted by the ARCADIS QA Officer or designee to ensure the data's suitability for its intended purpose. A functional guidelines data validation is not planned by ARCADIS at this time. However, a sufficiently detailed data package will be obtained by ARCADIS to permit a data validation to be performed should it be directed at a later time.

4.6 Corrective Action Procedures

During testing, every effort will be made to anticipate and resolve potential problems before the quality of the measurement performance is compromised. Personnel responsible for instrumentation and testing activities are cognizant of activities that can affect data quality. Field and laboratory personnel will be familiar with the contents of this work plan/SAP and associated appendices.

Problems that may adversely impact data quality will be corrected by the analyst who is responsible for interpreting the results of the daily calibration check and resolving potential problems based on the procedures referred to in the QAPP and will be reported to the ARCADIS QA manager. The ARCADIS QA manager will advise the project manager of problems and corrective actions that have been implemented. The field personnel will document corrective actions in bound notebooks. The ARCADIS field team leader and laboratory project manager are responsible for reporting data quality problems and corrective actions to the ARCADIS QA Officer, who will review the information. Data quality problems and necessary corrective actions will be reported to the client and regulatory agencies.

5. Reporting

A summary report will be prepared upon tabulation of the monitoring data. The report will summarize the air monitoring activities and will present the monitoring results for the air samples in tabular format.

The report will be submitted to the ODEQ and the EPA within 21 days of receipt of laboratory analytical data. Field data will be provided to the ODEQ and EPA as soon as possible upon completion of the real time monitoring event, but no later than five days after the completion of the field work. EPA and ODEQ will be immediately notified if any of the laboratory results suggest the need for emergency response actions.

5.1 On-site Worker Data Analysis Approach

Sample results pertaining to those gases determined by real time air monitors will be compared to action levels defined in the HASP. Field instrument results will also be compared to LEL levels, where applicable, and at a conservative basis of 10% of the LEL at the on-site ambient air measuring locations.

It is understood from the conference call discussion that EPA is concerned about the existence of an immediately dangerous to life or health (IDLH) concentration in some leachate recovery system components. These components are already restricted and are not to be entered without a confined space permit and proper ventilation. In addition to restricting access without ventilation, our HASP will require the use of explosion proof tools in the vicinity of these vents and sumps where landfill gas is likely to be present.

Emergency response procedures and contact information have been described in the Contingency Plan developed for this site. In the event of an emergency, the primary emergency coordinator/site manager, Dan Shaver, will be notified immediately. Any other personnel on the site shall be warned of the type of emergency as will the local authorities. The National Response Center will be contacted if the emergency involves a reportable spill or release.

At EPA's request, the extractive sample locations near the vents will be at a distance of one horizontal foot from the RCRA landfill vent caps at the height of the vent caps; CERCLA landfill sump samples will be 1 foot above ground surface. As such they will not be representative of a workers normal breathing zone, but will be representative of a worst case exposure expected be encountered for <2 minutes.

5.2 Off-site Worker Data Analysis Approach

Proposed screening levels for the gases at the fence line are shown on Table 1. These screening levels generally are based on short term exposure considerations.

Field instrument results will also be compared to LEL levels, where applicable, and at a conservative basis of 10% of the LEL at the fence line air measuring locations. The comparison of gases recorded at the fence line to 10% of the LEL is considered a very conservative approach in regard to potential explosive risk.

During the July 10, 2012, conference call, EPA also asked to be provided with assurance that all potential exposure pathways had been evaluated. In that regard we intend to use the results of this sampling round to revisit the air pathway assessments previously done in light of new information.

ARCADIS

Tables

Table 1. Air Sampling and Monitoring Methods

Analyte Name	Analyte Abbreviation	Reason for Measurement	Ambient Method	Media/Container	Hold Time	DL/PQL	Industrial Worker Ambient Air Screening Level (Perimeter)** Fence Line Screening Level	Industrial Worker Ambient Air Screening Level (Perimeter)** Source for Screening Level	Short-Term Air Screening Level (Perimeter)** Fence Line Screening Level	Short-Term Air Screening Level (Perimeter)** Source for Screening Level
Extractive Sampling and Analyses[a]										
Acetylene	**C_2H_2**	**Explosive/Toxic**	EPA TO-3 M	Tedlar or canister	Tedler: 72 hrs Canister: 30 days	0.5 ppm	2.5% v/v LEL	http://www.engineeringtoolbox.com/explosive-concentration-limits-d_423.html	2.5% v/v LEL	http://www.engineeringtoolbox.com/explosive-concentration-limits-d_423.html
Ammonia	**NH_3**	**Toxic**	OSHA ID 188/164	SKC-226-29	14 days at 4 ºC	MRL = 0.010 mg/sample; at 3 hour sampling time and 0.5 liters per minute 0.16 ppmv (0.112	440 ug/m^3	EPA Regional Screening Level** (RSL) Summary Table April 2012, Industrial Air	1180 ug/m^3	EPA Acute Minimal Risk Level (MRL) www.atsdr.cdc.gov/mrls/pdfs/atsdr_mrls_February_2012.pdf
Carbon Dioxide[b]	**CO_2**	**Asphyxiant**	ASTM D1946/ EPA 3C M	Tedlar or canister	Tedler: 72 hrs Canister: 30 days	1000 ppm	5000 ppm, 9000 mg/m^3	OSHA, 1910.100 Table Z-1, 8 hour TWA	30000 ppm, 54000 mg/m^3	ACGIH Threshold Limit Value (TLV) Short Term Exposure Limit (STEL) 15-minute TWA
Hydrogen Fluoride	**HF**	**Toxic**	NMAM 7903	SKC 226-10-03	21 days at room temperature	2.5 ug/m^3 (MRL 0.53 µg/sample)	61 ug/m^3	EPA Regional Screening Level** (RSL) Summary Table April 2012, Industrial Air	820 ug/m^3	Acute Exposure Guideline Level 1 (AEGL 1) (transient effects), 8-hr, http://www.epa.gov/oppt/aegl/pubs/compiled_aegls_nov072011.pdf
Hydrogen[b]	**H_2**	**Explosive**	ASTM D1946/ EPA 3C M	Tedlar or canister	Tedler: 72 hrs Canister: 30 days	1000 ppm	4.0% v/v LEL	http://www.engineeringtoolbox.com/explosive-concentration-limits-d_423.html	4.0% v/v LEL	http://www.engineeringtoolbox.com/explosive-concentration-limits-d_423.html
Hydrogen Cyanide	**HCN**	**Toxic**	NMAM 6010	SKC 226-28	14 days at room temperature	2 ppbv 2.2 ug/m^3 (MRL 0.21 µg/sample)	3.5 ug/m^3	EPA Regional Screening Level** (RSL) Summary Table April 2012, Industrial Air	1105 ug/m^3	Acute Exposure Guideline Level 1 (AEGL 1) (transient effects), 8-hr, http://www.epa.gov/oppt/aegl/pubs/compiled_aegls_nov072011.pdf
Hydrogen Sulfide	**H_2S**	**Toxic**	ASTM-D-5504-08	Tedlar bag	24 hours	4 ppbv (5.6 ug/m3)	8.8 ug/m3	EPA Regional Screening Level** (RSL) Summary Table April 2012, Industrial Air	97 ug/m3	EPA Acute Minimal Risk Level (MRL) www.atsdr.cdc.gov/mrls/pdfs/atsdr_mrls_February_2012.pdf
Hydrogen Sulfide	**H_2S**	**Toxic**	OSHA 1008	Sorbent Tube	14 days	520 ppbv (724 $µg/m^3$) (4-hr sample collection	8.8 ug/m^3	EPA Regional Screening Level** (RSL) Summary Table April 2012, Industrial Air	97 ug/m^3	EPA Acute Minimal Risk Level (MRL) www.atsdr.cdc.gov/mrls/pdfs/atsdr_mrls_February_2012.pdf
Methane[b]	**CH_4**	**Explosive**	ASTM D1946/ EPA 3C M	Tedlar or canister	Tedler: 72 hrs Canister: 30 days	1000 ppm	5%v/v LEL	http://www.engineeringtoolbox.com/explosive-concentration-limits-d_423.html	5%v/v LEL	http://www.engineeringtoolbox.com/explosive-concentration-limits-d_423.html
Nitrogen[b]	**N_2**	**Balance gas**	ASTM D1946/ EPA 3C M	Tedlar or canister	Tedler: 72 hrs Canister: 30 days	1000 ppm	N/A	N/A	N/A	N/A
Oxygen[b]	**O_2**	**Asphyxiant**	ASTM D1946/ EPA 3C M	Tedlar or canister	Tedler: 72 hrs Canister: 30 days	1000 ppm	if ≤ 19.5% v/v	http://www.osha.gov/dte/library/respirators/major_requirements.pdf	if ≤ 19.5% v/v	http://www.osha.gov/dte/library/respirators/major_requirements.pdf
Phosphine	**PH_3**	**Toxic**	OSHA 1003	SKC 225-9018, treated filter	17 days at room temperature	22.9 ug/m3 using a 240 liter sample (1 liter per minute for 4 hours) (MRL 5.5	1.3 ug/m^3	EPA Regional Screening Level** (RSL) Summary Table April 2012, Industrial Air	700 ug/m^3 max for 1-hr	ERPG (Emergency Response Planning Guidelines, American Industrial Hygiene Association) (AIHA 2002), http://www.nap.edu/catalog/12018.html
Field Portable Monitoring										
Acetylene	**C_2H_2**	**Explosive/Toxic**	RIK Eagle 2 w/TC	N/A	Continuous	0.1% v/v	2.5% v/v LEL	N/A	2.5% v/v LEL	N/A
Ammonia	**NH_3**	**Toxic**	MX6 I-Brid **or** RIK Eagle 2 w/TC	N/A	Continuous	0.1 ppmv	440 ug/m^3	EPA Regional Screening Level** (RSL) Summary Table April 2012, Industrial Air	1180 ug/m^3	EPA Acute Minimal Risk Level (MRL) www.atsdr.cdc.gov/mrls/pdfs/atsdr_mrls_February_2012.pdf
Carbon Dioxide	**CO_2**	**Asphyxiant**	MX6 I-Brid	N/A	Continuous	0.1 ppmv	5000 ppm, 9000 mg/m^3	OSHA, 1910.100 Table Z-1, 8 hour TWA	30000 ppm, 54000 mg/m^3	ACGIH Threshold Limit Value (TLV) Short Term Exposure Limit (STEL) 15-minute TWA
Hydrogen Fluoride	**HF**	**Toxic**	Sensidyne Colorimetric Tube 156S with AP-20S hand pump	Colorimetric tube	Instantaneous	0.25 ppm (205 ug/m3) with 6 strokes (600 mls)	61 ug/m^3	EPA Regional Screening Level** (RSL) Summary Table April 2012, Industrial Air	820 ug/m^3	Acute Exposure Guideline Level 1 (AEGL 1) (transient effects), 8-hr, http://www.epa.gov/oppt/aegl/pubs/compiled_aegls_nov072011.pdf
Hydrogen	**H_2**	**Explosive**	RKI Eagle 2 w/TC	N/A	Continuous	0.1% v/v	4.0% v/v LEL	http://www.engineeringtoolbox.com/explosive-concentration-limits-d_423.html	4.0% v/v LEL	http://www.engineeringtoolbox.com/explosive-concentration-limits-d_423.html
Hydrogen Cyanide	**HCN**	**Toxic**	MX6 I-Brid **or** RIK Eagle 2 w/TC	N/A	Continuous	0.1 ppmv	3.5 ug/m^3	EPA Regional Screening Level** (RSL) Summary Table April 2012, Industrial Air	1105 ug/m^3	Acute Exposure Guideline Level 1 (AEGL 1) (transient effects), 8-hr, http://www.epa.gov/oppt/aegl/pubs/compiled_aegls_nov072011.pdf
Hydrogen Sulfide	**H_2S**	**Toxic**	MX6 I-Brid **or** RIK Eagle 2 w/TC	N/A	Continuous	0.1 ppmv	8.8 ug/m^3	EPA Regional Screening Level** (RSL) Summary Table April 2012, Industrial Air	97 ug/m^3	EPA Acute Minimal Risk Level (MRL) www.atsdr.cdc.gov/mrls/pdfs/atsdr_mrls_February_2012.pdf
Methane	**CH_4**	**Explosive**	RIK Eagle 2 w/TC	N/A	Continuous	0.1% v/v	5%v/v LEL	http://www.engineeringtoolbox.com/explosive-concentration-limits-d_423.html	5%v/v LEL	http://www.engineeringtoolbox.com/explosive-concentration-limits-d_423.html
Nitrogen	**N_2**	**Balance gas**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Oxygen	**O_2**	**Asphyxiant**	MX6 I-Brid **or** RIK Eagle 2 w/TC	N/A	Continuous	0.1% v/v	if ≤ 19.5% v/v	http://www.osha.gov/dte/library/respirators/major_requirements.pdf	if ≤ 19.5% v/v	http://www.osha.gov/dte/library/respirators/major_requirements.pdf
Phosphine	**PH_3**	**Toxic**	MX6 I-Brid **or** RIK Eagle 2 w/TC	N/A	Continuous	100 ppbv	1.3 ug/m^3	EPA Regional Screening Level** (RSL) Summary Table April 2012, Industrial Air	700 ug/m^3 max for 1-hr	ERPG (Emergency Response Planning Guidelines, American Industrial Hygiene Association) (AIHA 2002), http://www.nap.edu/catalog/12018.html
On site Wind Direction		Predict Dispersion	Windsock, visual observation	NA	NA		NA	NA	NA	NA
On site Wind speed		Predict Dispersion	Kestrel 1000 or Dwyer wind meter	NA	NA		NA	NA	NA	NA
Flow		Predict Dispersion	EPA Method 2C or 2D, Laminar flow element	NA	NA		NA	NA	NA	NA
Lower Explosive Limit	**LEL**	**Explosive**	MX6 I-Brid **or** RIK Eagle 2 w/TC	N/A	Continuous	0.1% v/v	100%	N/A	100%	N/A

a = All extractive sample analyses will be performed by ALS Environmental (formerly Columbia Analytical Services) Simi Valley, CA, with the exception of HCN, HF, and PH_3, which will be performed by their Salt Lake City, UT laboratory.

b = CH_4, CO_2, H_2, N_2 and O_2 can be analyzed concurrently in the same sample.

CAS AQL = Columbia Analytical Services, Air Quality Laboratory
MRL = Method Reporting Limit
N/A = Not applicable.
NMAM = NIOSH Manual of Analytical Methods

OSHA = Occupational Safety and Health Administration
* - Normal ambient [~390 ppmv]

Table 2. Test Matrix

			QA/QC Samples		RCRA Landfill							CERCLA Landfill										
Analyte Name	Analyte Abbreviation	Method	Field/Trip Blank	Duplicate	Sump	Vent #1	Vent #2	Vent #3	Upwind of RCRA Landfill Outside Fence	Downwind of Landfill RCRA Outside of Fence	RCRA Utility Building	Nutrient Shack	CERCLA Utility Building	Upwind of CERCLA Landfill Outside Fence	Downwind of CERCLA Landfill Outside of Fence	Manhole #1	Manhole #2	Manhole #3	Manhole #4	Lift Station #1	Lift Station #2	Total Number of Samples Including QA/QC
Extractive Sampling and Analyses																						
Acetylene	**C_2H_2**	EPA TO-3 M	1	1	$2^{\&}$	1 from the location 1 ft away at the height of the vent and 1 inside the RCRA vent, both as indicated by the worst cases in the Field Instrument Monitoring			1	3	1 from worst case on site building location as indicated by Field Instrument Monitoring			1	3	1 from inside the worst case CERCLA manhole as indicated by Field Instrument Monitoring and 1 from a location 1 ft away and 2 ft above the worst case manhole as indicated by field instrument monitoring				1 from inside the worst case CERCLA lift station location as indicated by field Instrument monitoring and one from a location 1 ft away and 2 ft above the worst case lift station as indicated by field instrument monitoring		19
Ammonia	**NH_3**	OSHA ID 188/164	1	1	$2^{\&}$	1 from the location 1 ft away at the height of the vent and 1 inside the RCRA vent, both as indicated by the worst cases in the Field Instrument Monitoring			1	3	1 from worst case on site building location as indicated by Field Instrument Monitoring			1	3	1 from inside the worst case CERCLA manhole as indicated by Field Instrument Monitoring and 1 from a location 1 ft away and 2 ft above the worst case manhole as indicated by field instrument monitoring				1 from inside the worst case CERCLA lift station location as indicated by field Instrument monitoring and one from a location 1 ft away and 2 ft above the worst case lift station as indicated by field instrument monitoring		19
Carbon Dioxide[b]	**CO_2**	ASTM D1946/ EPA 3C M	1	1	$2^{\&}$	1 from the location 1 ft away at the height of the vent and 1 inside the RCRA vent, both as indicated by the worst cases in the Field Instrument Monitoring			1	3	1 from worst case on site building location as indicated by Field Instrument Monitoring			1	3	1 from inside the worst case CERCLA manhole as indicated by Field Instrument Monitoring and 1 from a location 1 ft away and 2 ft above the worst case manhole as indicated by field instrument monitoring				1 from inside the worst case CERCLA lift station location as indicated by field Instrument monitoring and one from a location 1 ft away and 2 ft above the worst case lift station as indicated by field instrument monitoring		19
Hydrofluoric Acid	**HF**	NMAM 7903	1	1	$2^{\&}$	1 from the location 1 ft away at the height of the vent and 1 inside the RCRA vent, both as indicated by the worst cases in the Field Instrument Monitoring			1	3	1 from worst case on site building location as indicated by Field Instrument Monitoring			1	3	1 from inside the worst case CERCLA manhole as indicated by Field Instrument Monitoring and 1 from a location 1 ft away and 2 ft above the worst case manhole as indicated by field instrument monitoring				1 from inside the worst case CERCLA lift station location as indicated by field Instrument monitoring and one from a location 1 ft away and 2 ft above the worst case lift station as indicated by field instrument monitoring		19
Hydrogen[b]	**H_2**	ASTM D1946/ EPA 3C M	1	1	$2^{\&}$	1 from the location 1 ft away at the height of the vent and 1 inside the RCRA vent, both as indicated by the worst cases in the Field Instrument Monitoring			1	3	1 from worst case on site building location as indicated by Field Instrument Monitoring			1	3	1 from inside the worst case CERCLA manhole as indicated by Field Instrument Monitoring and 1 from a location 1 ft away and 2 ft above the worst case manhole as indicated by field instrument monitoring				1 from inside the worst case CERCLA lift station location as indicated by field Instrument monitoring and one from a location 1 ft away and 2 ft above the worst case lift station as indicated by field instrument monitoring		19
Hydrogen Cyanide	**HCN**	NMAM 6010	1	1	$2^{\&}$	1 from the location 1 ft away at the height of the vent and 1 inside the RCRA vent, both as indicated by the worst cases in the Field Instrument Monitoring			1	3	1 from worst case on site building location as indicated by Field Instrument Monitoring			1	3	1 from inside the worst case CERCLA manhole as indicated by Field Instrument Monitoring and 1 from a location 1 ft away and 2 ft above the worst case manhole as indicated by field instrument monitoring				1 from inside the worst case CERCLA lift station location as indicated by field Instrument monitoring and one from a location 1 ft away and 2 ft above the worst case lift station as indicated by field instrument monitoring		19
Hydrogen Sulfide	**H_2S**	ASTM-D-5504-08 OSHA 1008	1	1	$2^{\&}$	1 from the location 1 ft away at the height of the vent and 1 inside the RCRA vent, both as indicated by the worst cases in the Field Instrument Monitoring			1	3	1 from worst case on site building location as indicated by Field Instrument Monitoring			1	3	1 from inside the worst case CERCLA manhole as indicated by Field Instrument Monitoring and 1 from a location 1 ft away and 2 ft above the worst case manhole as indicated by field instrument monitoring				1 from inside the worst case CERCLA lift station location as indicated by field Instrument monitoring and one from a location 1 ft away and 2 ft above the worst case lift station as indicated by field instrument monitoring		19
Methane[b]	**CH_4**	ASTM D1946/ EPA 3C M	1	1	$2^{\&}$	1 from the location 1 ft away at the height of the vent and 1 inside the RCRA vent, both as indicated by the worst cases in the Field Instrument Monitoring			1	3	1 from worst case on site building location as indicated by Field Instrument Monitoring			1	3	1 from inside the worst case CERCLA manhole as indicated by Field Instrument Monitoring and 1 from a location 1 ft away and 2 ft above the worst case manhole as indicated by field instrument monitoring				1 from inside the worst case CERCLA lift station location as indicated by field Instrument monitoring and one from a location 1 ft away and 2 ft above the worst case lift station as indicated by field instrument monitoring		19
Nitrogen[b]	**N_2**	ASTM D1946/ EPA 3C M	1	1	$2^{\&}$	1 from the location 1 ft away at the height of the vent and 1 inside the RCRA vent, both as indicated by the worst cases in the Field Instrument Monitoring			1	3	1 from worst case on site building location as indicated by Field Instrument Monitoring			1	3	1 from inside the worst case CERCLA manhole as indicated by Field Instrument Monitoring and 1 from a location 1 ft away and 2 ft above the worst case manhole as indicated by field instrument monitoring				1 from inside the worst case CERCLA lift station location as indicated by field Instrument monitoring and one from a location 1 ft away and 2 ft above the worst case lift station as indicated by field instrument monitoring		19

Table 2. Test Matrix

			QA/QC Samples		RCRA Landfill							CERCLA Landfill										
Analyte Name	Analyte Abbreviation	Method	Field/Trip Blank	Duplicate	Sump	Vent #1	Vent #2	Vent #3	Upwind of RCRA Landfill Outside Fence	Downwind of Landfill RCRA Outside of Fence	RCRA Utility Building	Nutrient Shack	CERCLA Utility Building	Upwind of CERCLA Landfill Outside Fence	Downwind of CERCLA Landfill Outside of Fence	Manhole #1	Manhole #2	Manhole #3	Manhole #4	Lift Station #1	Lift Station #2	Total Number of Samples Including QA/QC
Oxygen[b]	**O_2**	ASTM D1946/ EPA 3C M	1	1	2[&]	1 from the location 1 ft away at the height of the vent and 1 inside the RCRA vent, both as indicated by the worst cases in the Field Instrument Monitoring			1	3	1 from worst case on site building location as indicated by Field Instrument Monitoring			1	3	1 from inside the worst case CERCLA manhole as indicated by Field Instrument Monitoring and 1 from a location 1 ft away and 2 ft above the worst case manhole as indicated by field instrument monitoring				1 from inside the worst case CERCLA lift station location as indicated by field Instrument monitoring and one from a location 1 ft away and 2 ft above the worst case lift station as indicated by field instrument monitoring		19
Phosphine	**PH_3**	OSHA 1003	1	1	2[&]	1 from the location 1 ft away at the height of the vent and 1 inside the RCRA vent, both as indicated by the worst cases in the Field Instrument Monitoring			1	3	1 from worst case on site building location as indicated by Field Instrument Monitoring			1	3	1 from inside the worst case CERCLA manhole as indicated by Field Instrument Monitoring and 1 from a location 1 ft away and 2 ft above the worst case manhole as indicated by field instrument monitoring				1 from inside the worst case CERCLA lift station location as indicated by field Instrument monitoring and one from a location 1 ft away and 2 ft above the worst case lift station as indicated by field instrument monitoring		19

Table 2. Test Matrix

			QA/QC Samples		RCRA Landfill							CERCLA Landfill										
Analyte Name	**Analyte Abbreviation**	**Method**	**Field/Trip Blank**	**Duplicate**	**Sump**	**Vent #1**	**Vent #2**	**Vent #3**	**Upwind of RCRA Landfill Outside Fence**	**Downwind of Landfill RCRA Outside of Fence**	**RCRA Utility Building**	**Nutrient Shack**	**CERCLA Utility Building**	**Upwind of CERCLA Landfill Outside Fence**	**Downwind of CERCLA Landfill Outside of Fence**	**Manhole #1**	**Manhole #2**	**Manhole #3**	**Manhole #4**	**Lift Station #1**	**Lift Station #2**	**Total Number of Samples Including QA/QC**
Field Instrument Monitoring																						
Acetylene	C_2H_2	RIK Eagle 2 w/TC	NA	NA	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Numerous
Ammonia	NH_3	MX6 I-Brid **or** RIK Eagle 2 w/TC	NA	NA	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Numerous
Carbon Dioxide	CO_2	MX6 I-Brid	NA	NA	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Numerous
Hydrogen Fluoride	HF	Sensidyne 156S Detector Tube with AP-20S pump	1	1	Up to 16 samples will be taken at locations where an indication of landfill related gasses may be seen in instrument survey results.																	up to 18
Hydrogen	H_2	RIK Eagle 2 w/TC	NA	NA	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Numerous
Hydrogen Cyanide	HCN	MX6 I-Brid **or** RIK Eagle 2 w/TC	NA	NA	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Numerous
Hydrogen Sulfide	H_2S	MX6 I-Brid **or** RIK Eagle 2 w/TC	NA	NA	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Numerous
Methane	CH_4	RIK Eagle 2 w/TC	NA	NA	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Numerous
Nitrogen	N_2	N/A	NA	NA	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Numerous
Oxygen	O_2	MX6 I-Brid **or** RIK Eagle 2 w/TC	NA	NA	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Numerous
Phosphine	PH_3	MX6 I-Brid **or** RIK Eagle 2 w/TC	NA	NA	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Numerous
																						Numerous
Lower Explosive Limit	LEL	MX6 I-Brid **or** RIK Eagle 2 w/TC	NA	NA	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Survey*	Numerous

a = All extractive analyses will be performed by ALS Environmental (formerly Columbia Analytical Services) Simi Valley, CA, with the exception of HCN, HF, and PH_3, which will be performed by their Salt Lake City, UT laboratory.

b = CH_4, CO_2, H_2, N_2 and O_2 can be analyzed concurrently in the same sample.

CAS AQL = Columbia Analytical Services Air Quality Laboratory

MRL = Method Reporting Limit

N/A = Not applicable.

NMAM = NIOSH Manual of Analytical Methods

Survey* = All locations will be field monitored as described in Scetions 2.1 through 2.3 of the SAP.

& = one sample from within the point source and one sample from one ft away at 2 ft above the ground or vent height

Table 3 Laboratory Data Quality Objectives

							Data Quality Objectives		
Analyte Name	**Analyte Abbreviation**	**Reason for Measurement**	**Ambient Method**	**Media/Container**	**Hold Time**	**DL/PQL**	**Accuracy (%)**	**Precision (% RPD)**	**Completeness (%)**
Extractive Sampling and Analyses[a]									
Acetylene	C_2H_2	**Explosive/Toxic**	EPA TO-3 M	Tedlar or canister	Tedler: 72 hrs Canister: 30 days	0.5 ppm	80-120%	25% RPD	90
Ammonia	NH_3	**Toxic**	OSHA ID 188/164	SKC-226-29	14 days at 4 °C	MRL = 0.010 mg/sample; at 3 hour sampling time and 0.5 liters per minute 0.16 ppmv	LCS % Rec. 80-104	% RPD of lab duplicate 10%; % RPD of field duplicate 15%	90
Carbon Dioxide[b]	CO_2	**Asphyxiant**	ASTM D1946/ EPA 3C M	Tedlar or canister	Tedler: 72 hrs Canister: 30 days	1000 ppm	LCS Recovery 87-117%	19% RPD of lab duplicate, 30 % RPD of field duplicate	90
Hydrogen Fluoride	HF	**Toxic**	NMAM 7903	SKC 226-10-03	21 days at room temperature	2.5 ug/m^3 (MRL 0.53 µg/sample)	75-125%	25% RPD	90
Hydrogen[b]	H_2	**Explosive**	ASTM D1946/ EPA 3C M	Tedlar or canister	Tedler: 72 hrs Canister: 30 days	1000 ppm	LCS % Rec. 83-122	17% RDP of lab duplicate, 25% rpd of field duplicate	90
Hydrogen Cyanide	HCN	**Toxic**	NMAM 6010	SKC 226-28	14 days at room temperature	2 ppbv 2.2 ug/m^3 (MRL 0.21 µg/sample)	80-120%	25% RPD	90
Hydrogen Sulfide	H_2S	**Toxic**	ASTM-D-5504-08	Tedlar bag	24 hours	4 ppbv (5.6 ug/m^3)	80-120%	25% RPD	90
Methane[b]	CH_4	**Explosive**	ASTM D1946/ EPA 3C M	Tedlar or canister	Tedler: 72 hrs Canister: 30 days	1000 ppm	LCS Recovery 84-113%	18% RPD of lab duplicate, 25 % RPD of field duplicate	90
Nitrogen[b]	N_2	**Balance gas**	ASTM D1946/ EPA 3C M	Tedlar or canister	Tedler: 72 hrs Canister: 30 days	1000 ppm	LCS Recovery 76-126%	19% RPD of lab duplicate, 30 % RPD of field duplicate	90
Oxygen[b]	O_2	**Asphyxiant**	ASTM D1946/ EPA 3C M	Tedlar or canister	Tedler: 72 hrs Canister: 30 days	1000 ppm	LCS Recover 74-132%	19% RPD of lab duplicate, 30 % RPD of field duplicate	90
Phosphine	PH_3	**Toxic**	OSHA 1003	SKC 225-9018, treated filter	17 days at room temperature	22.9 ug/m3 using a 240 liter sample (1 liter per minute for 6 hours) (MRL 5.5 µg/sample)	80-120%	15% RPD	90
Field Portable Monitoring									
Acetylene	C_2H_2	**Explosive/Toxic**	RIK Eagle 2 w/TC	N/A	Continuous	0.1% v/v	75-125% on linearity check gas and continuing calibration of span gasses	25% RPD on replicate analyses of linearity check gas	90
Ammonia	NH_3	**Toxic**	MX6 I-Brid **or** RIK Eagle 2 w/TC	N/A	Continuous	0.1 ppmv	75-125% on linearity check gas and continuing calibration of span gasses	25% RPD on replicate analyses of linearity check gas	90
Carbon Dioxide	CO_2	**Asphyxiant**	MX6 I-Brid or RIK Eagle 2 w/TC	N/A	Continuous	0.1 ppmv	75-125% on linearity check gas and continuing calibration of span gasses	25% RPD on replicate analyses of linearity check gas	90
Hydrogen Fluoride	HF	**Toxic**	Sensidyne colorimetric tube 156S with AR-20S hand pump	Colorimetric tube	Instantaneous	0.25 ppm 205 ug/m3 with 6 strokes (600 mls)	60-140%	40% RPD	90
Hydrogen	H_2	**Explosive**	RKI Eagle 2 w/TC	N/A	Continuous	0.1% v/v	75-125% on linearity check gas and continuing calibration of span gasses	25% RPD on replicate analyses of linearity check gas	90
Hydrogen Cyanide	HCN	**Toxic**	MX6 I-Brid **or** RIK Eagle 2 w/TC	N/A	Continuous	0.1 ppmv	75-125% on linearity check gas and continuing calibration of span gasses	25% RPD on replicate analyses of linearity check gas	90
Hydrogen Sulfide	H_2S	**Toxic**	MX6 I-Brid **or** RIK Eagle 2 w/TC	N/A	Continuous	0.1 ppmv	75-125% on linearity check gas and continuing calibration of span gasses	25% RPD on replicate analyses of linearity check gas	90
Methane	CH_4	**Explosive**	RIK Eagle 2 w/TC	N/A	Continuous	0.1% v/v	75-125% on linearity check gas and continuing calibration of span gasses	25% RPD on replicate analyses of linearity check gas	90
Nitrogen	N_2	**Balance gas**	N/A	N/A	N/A	N/A	NA	NA	90
Oxygen	O_2	**Asphyxiant**	MX6 I-Brid **or** RIK Eagle 2 w/TC	N/A	Continuous	0.1% v/v	75-125% on linearity check gas and continuing calibration of span gasses	25% RPD on replicate analyses of linearity check gas	90
Phosphine	PH_3	**Toxic**	MX6 I-Brid **or** RIK Eagle 2 w/TC	N/A	Continuous	100 ppbv	75-125% on linearity check gas and continuing calibration of span gasses	25% RPD on replicate analyses of linearity check gas	90
On site Wind Direction		Predict Dispersion	Windsock, visual observation	NA	NA		+/- 30 DEGREES	NA	90
On site Wind speed		Predict Dispersion	Kestrel 1000 or Dwyer wind meter	NA	NA		+/- 3 MPH	NA	90
Flow		Predict Dispersion	EPA Method 2C or 2D, Laminar flow element	NA	NA		+-30%	25% RPD	90
Lower Explosive Limit	LEL	**Explosive**	MX6 I-Brid **or** RIK Eagle 2 w/TC	N/A	Continuous	0.1% v/v	75-125% on linearity check gas and continuing calibration of span gasses	25% RPD on replicate analyses of linearity check gas	90

a = All extractive sample analyses will be performed by ALS Environmental (formerly Columbia Analytical Services) Simi Valley, CA, with the exception of HCN, HF, and PH_3, which will be performed by their Salt Lake City, UT laboratory.

b = CH_4, CO_2, H_2, N_2 and O_2 can be analyzed concurrently in the same sample.

CAS AQL = Columbia Analytical Services, Air Quality Laboratory
MRL = Method Reporting Limit
N/A = Not applicable.
NMAM = NIOSH Manual of Analytical Methods

OSHA = Occupational Safety and Health Administration
* - Normal ambient [~390 ppmv]

Figures

LEGEND

MW-41S CERCLA LANDFILL MONITORING WELL LOCATION

MW-37S RCRA LANDFILL MONITORING WELL LOCATION

LOCKHEED MARTIN CORPORATION OWNERSHIP

THE DALLES, OREGON

0 350 700 1050
APPROXIMATE SCALE IN FEET
1" = 700'

Drafter	M. HOEFER
Project Manager	K.W. SMITH
Task Manager	M. RISHER
Technical Review	M. RISHER / KW SMITH

ARCADIS U.S., Inc.
1610 B Street, Suite 100
Helena, MT 59601
Tel: 406-449-7001 Fax: 406-449-3063
www.arcadis-us.com

LOCKHEED MARTIN CORPORATION
SITE LAYOUT - FACILITIES AND PROJECT AREAS

LOCKHEED MARTIN CORPORATION SITE
THE DALLES, OREGON

Project Number MH000986.0001
Drawing Date 12/03/10
Figure 1

Acad Version : R17.0s (LMS Tech) Date\Time : Fri, 03 Dec 2010 - 9:51am Current Plotstyle : ByColor Layout Tab: Aerial Photo (2)
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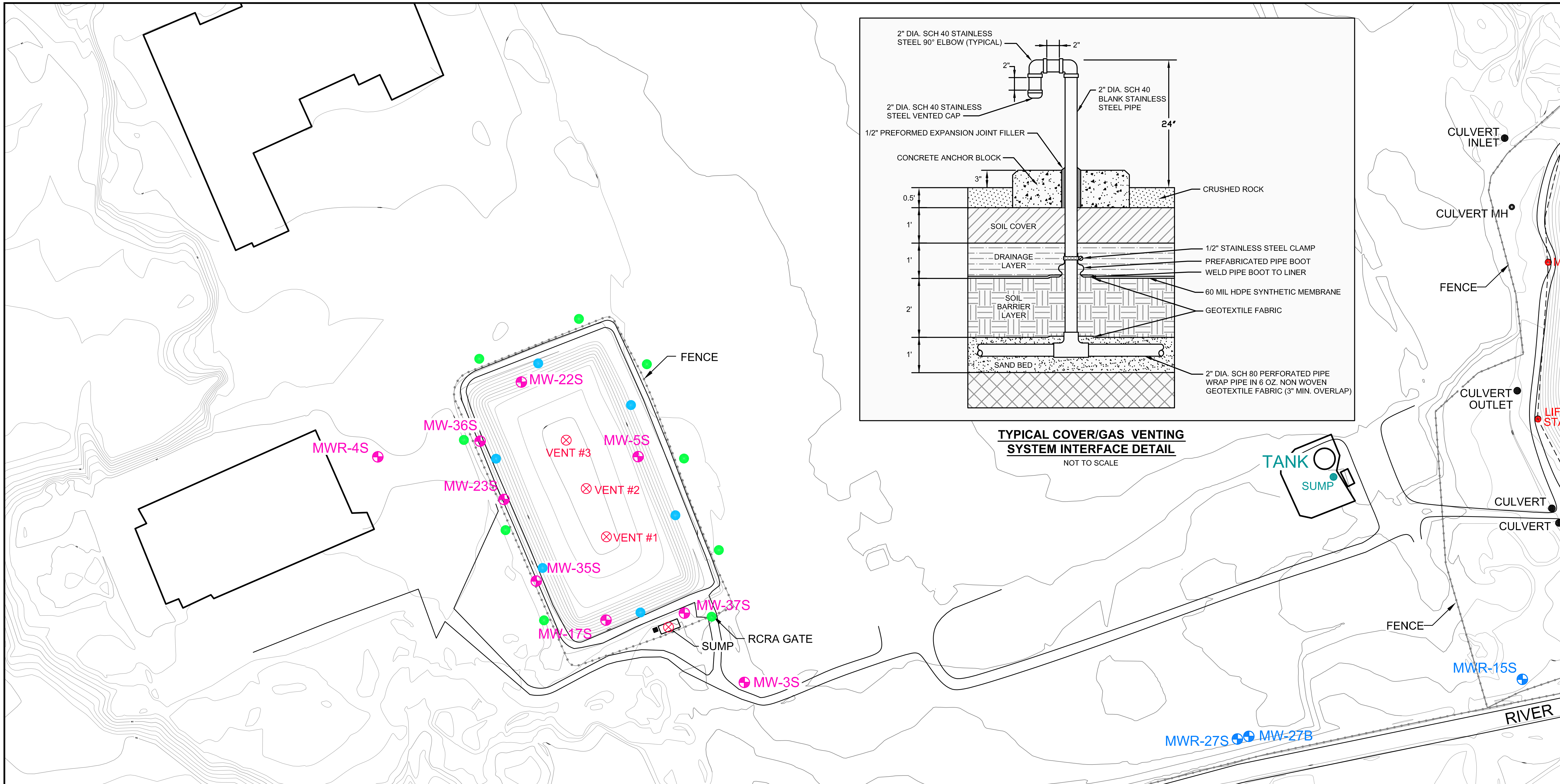


LEGEND

MW-41S CERCLA LANDFILL MONITORING WELL LOCATION
MW-37S RCRA LANDFILL MONITORING WELL LOCATION
MH #4 MANHOLE
CAP DRAINS
PERIMETER SAMPLES
VENTS AND SUMP

RCRA LANDFILL

PERIMETER MONITORING
STARTING WITH THE LANDFILL GATE, MONITOR READING EVERY 200' (10)
DOWNWIND LOCATION TBD (1)

SOURCE SAMPLING LOCATIONS
LANDFILL VENTS (3)
ADJACENT TO THE RCRA SUMP (1)
RCRA CAP DRAINS (6)

NOTE
AS SPECIFIC IN THE TEXT, ADDITIONAL SAMPLE LOCATIONS ARE TO BE LOCATED BASED ON WIND DIRECTION OR INITIAL RESULTS. THE SAMPLE LOCATIONS ARE NOT SHOWN ON THIS FIGURE.

N
0 100' 200' 300'
APPROXIMATE SCALE IN FEET
1" = 200'

Acad Version : R18.1s (LMS Tech) Date\Time : Mon, 27 Aug 2012 - 5:02pm
User Name : MHoefer Path\Name : C:\Montana\LMC\COLOC-0484.dwg
Current Plotstyle : ByColor
Layout Tab: FIG 2

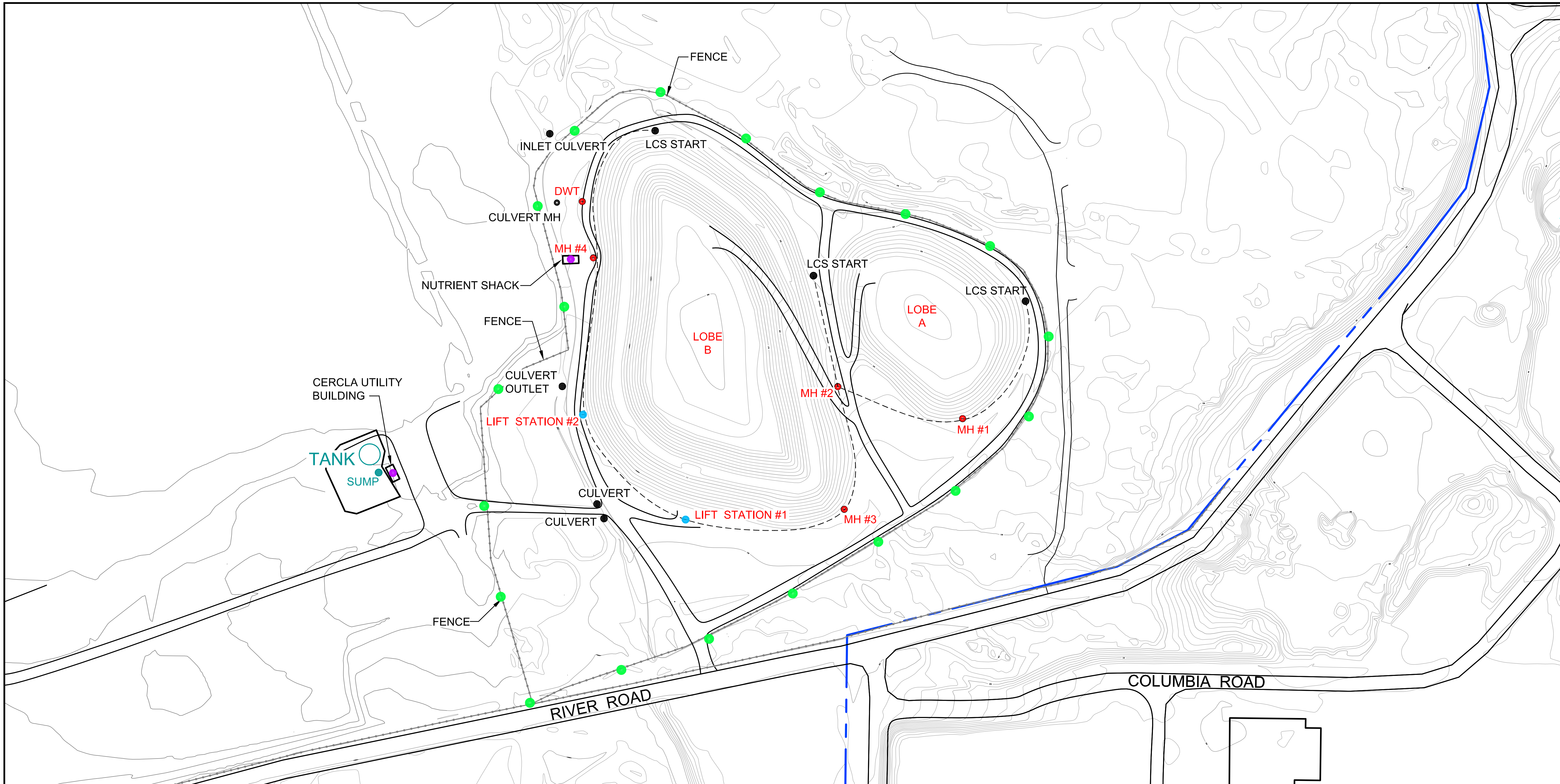
Drafter: M. HOEFER
Project Manager: K.W. SMITH
Task Manager: M. RISHER
Technical Review: M. RISHER / K.W. SMITH

ARCADIS
Arcadis U.S., Inc.
1610 B Street, Suite 100
Helena, MT 59601
Tel: 406-449-7001 Fax: 406-449-3063
www.arcadis-us.com

RCRA LANDFILL
AREA SAMPLING LOCATIONS

LOCKHEED MARTIN CORPORATION SITE
THE DALLES, OREGON

Project Number: GP000677.2012
Drawing Date: 08/27/12
Figure: 2



LEGEND		CERCLA LANDFILL MONITORING AND SAMPLING LOCATIONS
MH #3	MANHOLE	MANHOLES (4)
LIFT STATION #1	LIFT STATION	LIFT STATIONS (2)
	NUTRIENT SHACK AND CERCLA UTILITY BUILDING	NUTRIENT SHACK (1)
	PERIMETER SAMPLES	CERCLA UTILITY BUILDING (1)

NOTE

AS SPECIFIC IN THE TEXT, ADDITIONAL SAMPLE LOCATIONS ARE TO BE LOCATED BASED ON WIND DIRECTION OR INITIAL RESULTS. THE SAMPLE LOCATIONS ARE NOT SHOWN ON THIS FIGURE.

N

0 100' 200' 300'

APPROXIMATE SCALE IN FEET
1" = 200'

Drafter: M. HOEFER
Project Manager: K.W. SMITH
Task Manager: M. RISHER
Technical Review: M. RISHER / K.W. SMITH

ARCADIS

ARCADIS U.S., Inc.
1610 B Street, Suite 100
Helena, MT 59601
Tel: 406-449-7001 Fax: 406-449-3063
www.arcadis-us.com

CERCLA LANDFILL
AREA SAMPLING LOCATIONS

LOCKHEED MARTIN CORPORATION SITE
THE DALLES, OREGON

Project Number: GP000677.2012
Drawing Date: 08/27/12
Figure: 3

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ARCADIS

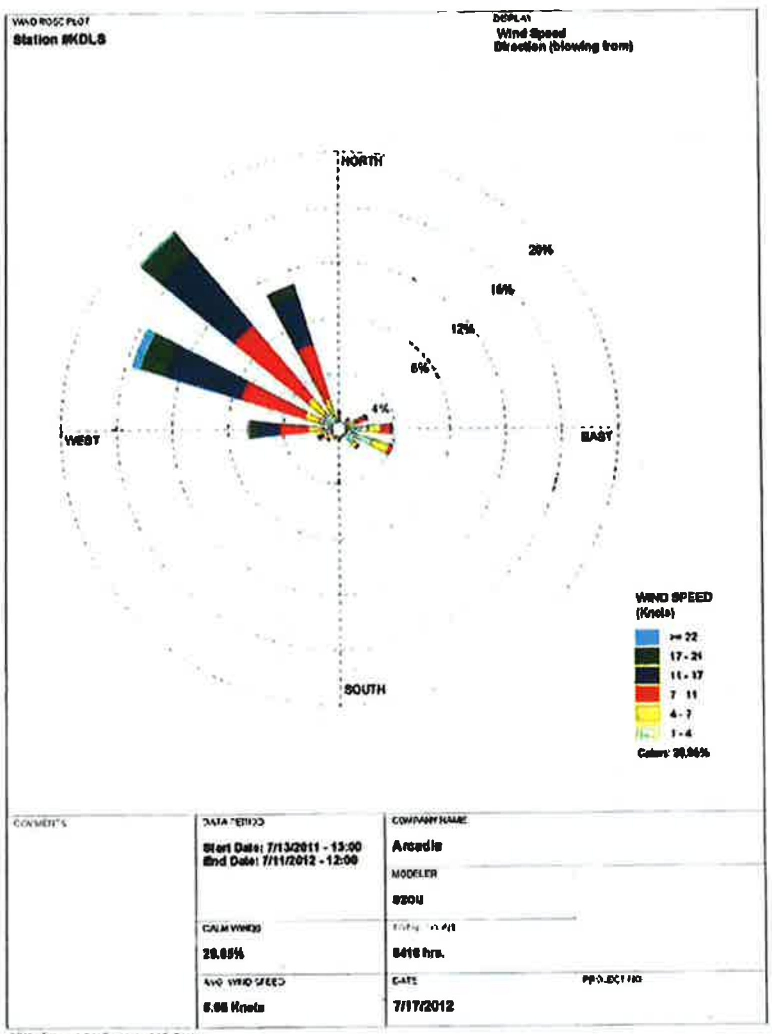
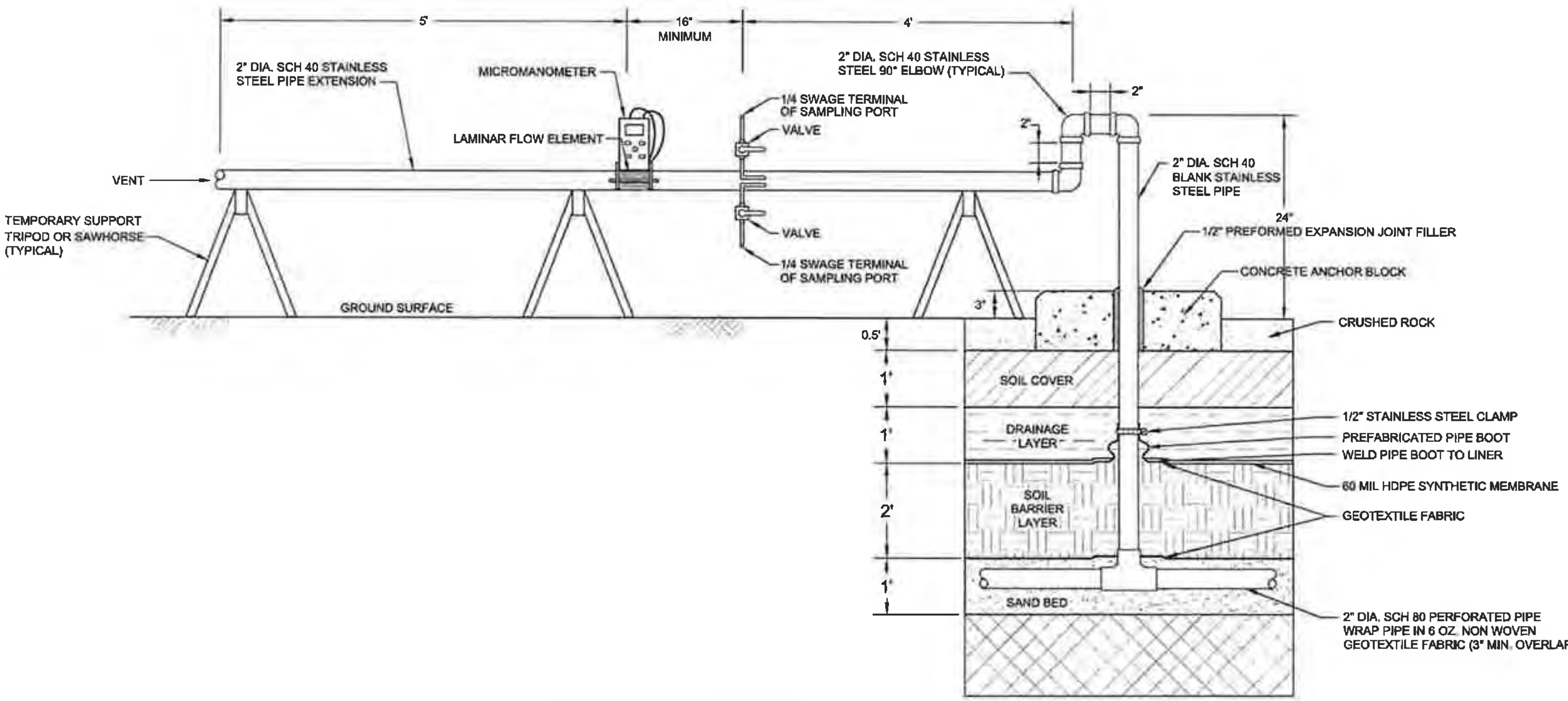


Figure 4. **One Year Wind Rose Using Hourly Reading from July 13th 2011 through July 11, 2012**



TYPICAL COVER/GAS VENTING SYSTEM INTERFACE DETAIL

NOT TO SCALE

LOCKEED MARTIN CORPORATION SITE
THE DALLES, OREGON
SAMPLING REPORT

FLOW MEASUREMENT AND SAMPLING MANIFOLD

ARCADIS

FIGURE 5